phoenix
vessel technology ltd

User's Guide 1 to:
Phoenix Vessel Technology Limited

1000 psi End port pressure vessels 2.5".
Model number: 1503

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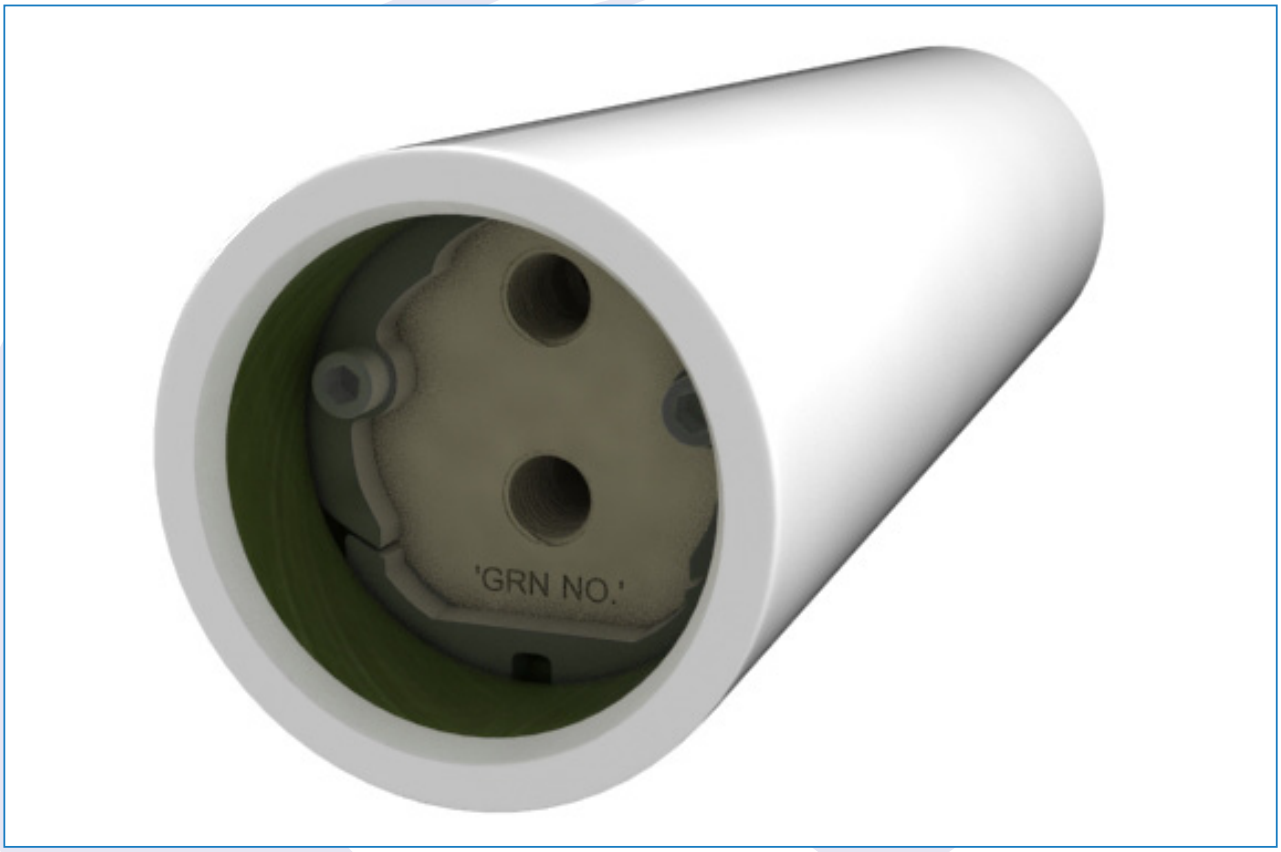
FORWARD

Phoenix Vessel Technology is a major manufacturer of Glass Reinforced Plastic Pressure Vessels which are used as housings for reverse osmosis membrane elements. It is one of a small number of companies with Code X accreditation of the American Society of Mechanical Engineers.

Only one model of 2.5” pressure vessel is produced, this is rated at 1000 psi and upto 2 (40”) elements in length.

Each vessel has a documented history in terms of the manufacturing process and the materials used. Before despatch, each vessel is tested to 1.1 times working pressure to ensure structural integrity.



The following Assembly Drawings are applicable:

1MNC 1503 - 2.5” 1000 psi 113^{O}F (45^{O}C)

User’s Guide Issue: Feb 2012

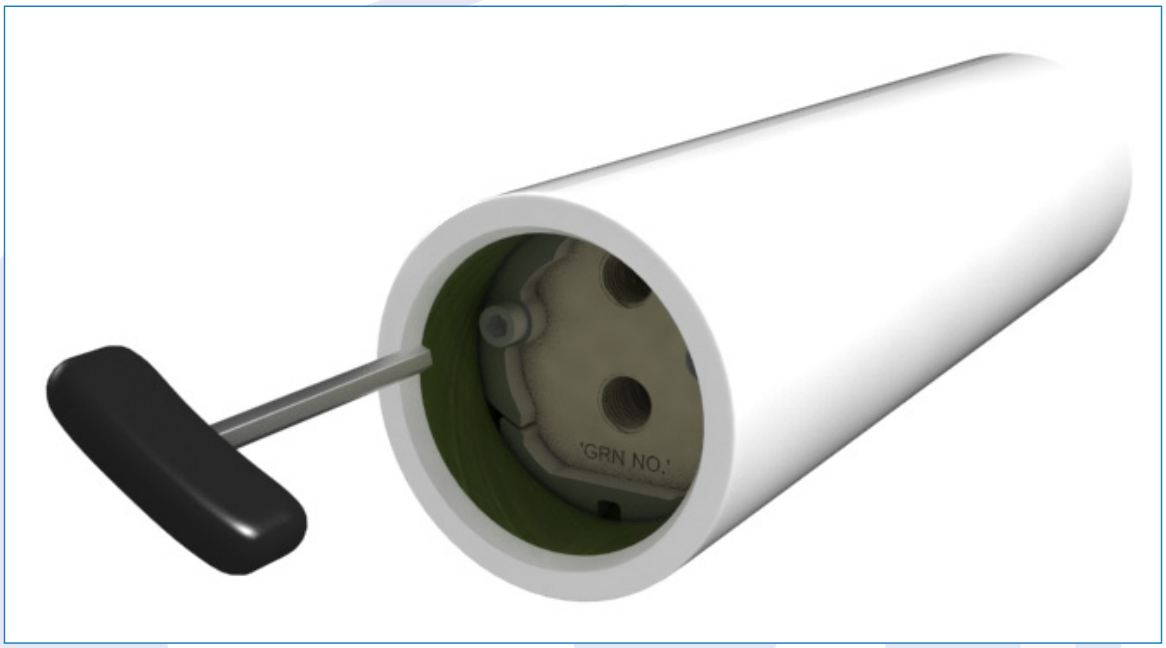
SECTION ONE
MAINTENANCE GUIDE

1.1 REMOVING END CAP FROM VESSEL

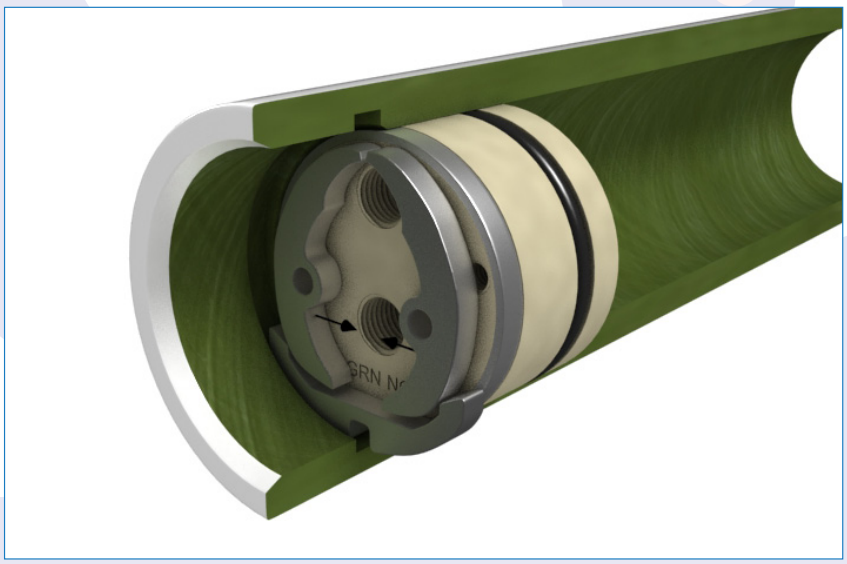
1.1.1 Ensure system is NOT pressurised before starting work.

1.1.2. Remove couplings connecting vessel ports to manifolds and move them clear of the vessel. Remove connections if fitted from the central product port.

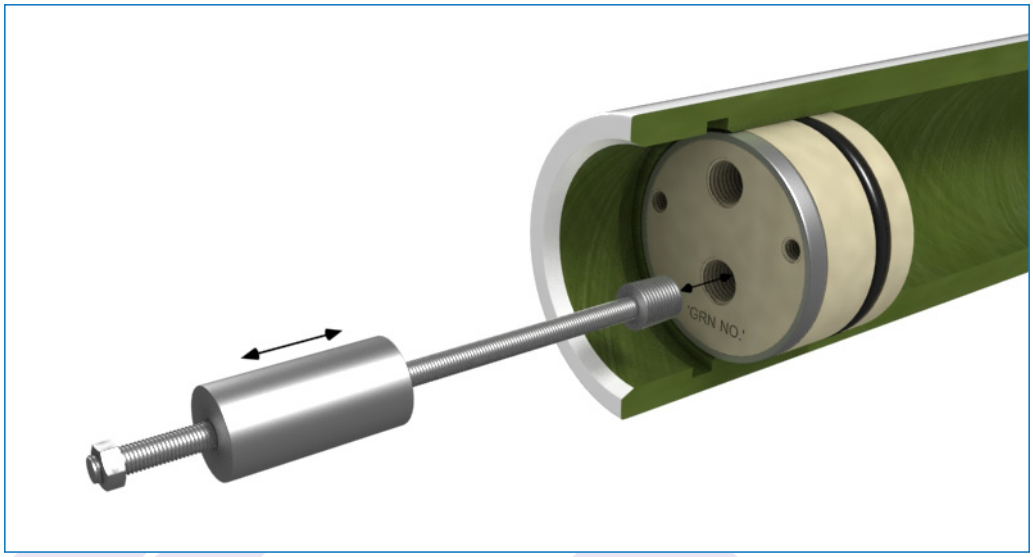
1.1.3. Using an 5mm hexagonal T bar or Allen key remove the 2 caphead screws holding the retaining ring in position.



1.1.4 Remove the 3 part retaining ring set. Each piece has a slot or hole enabling it to be levered out



1.1.5 If the end cap cannot be removed as indicated then the use of an extractor will be necessary. This is of the sliding impact hammer type and can be supplied by Phoenix Vessels.



1.4 LOADING MEMBRANES

This Section is provided as a Guide only, reference should be made to the element manufacturers recommendations for loading.

1.4.1 UNLOADING MEMBRANE ELEMENTS

(a) Ensure system is NOT pressurised before starting work.
(b) Remove both end caps from vessel.
(c) Remove element from vessel following element manufacturers recommendations.

1.4.2 CHECKS BEFORE LOADING

(a) Check the inside of the vessel for debris which may scratch the vessel. Remove any that is found by flushing with water or by using a clean cloth. Stubborn debris which adheres to the vessel may be removed by lightly polishing the area with waterproof silicone carbide paper. Use 400 Grade (fine) to start with and finish with 600 Grade (very fine). It will help to moisten the grit paper with water during use. Avoid continuously rubbing the same spot in the same direction. Afterwards remove any debris with water or by using a clean cloth.

(b) Check that there are no sharp edges to the membrane element which could scratch the vessel. Contact the element manufacturer if these cannot be easily removed.

(c) Check the element brine seal for wear and or cuts. Consult the element manufacturer for spares and advice.

NOTE: Sharp debris may scratch vessel bore. This should be removed before unloading elements.

NOTE: Fine grade Scotchbrite may be substituted for waterproof silicone carbide paper.

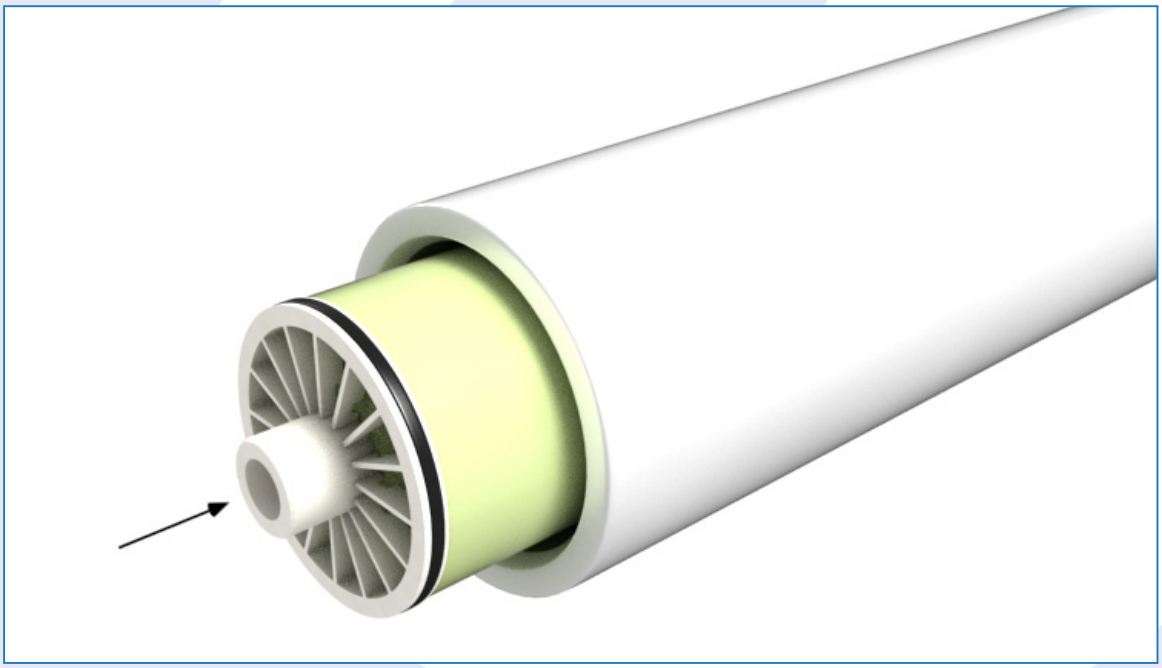
1.4.3 LOADING MEMBRANE ELEMENTS

(a) Lubricate the inside of the vessel with glycerine. If this is not available then flood vessel with clean water.

(b) Check with the element manufacturer concerning the position of the brine seal. Normally this is placed on the upstream end of the element with the recessed part of the seal pointing upstream.

(c) Lubricate the element brine seal with glycerine (do not use diluted glycerine) and push the element into the vessel using hands only (thumbs and base of palm).

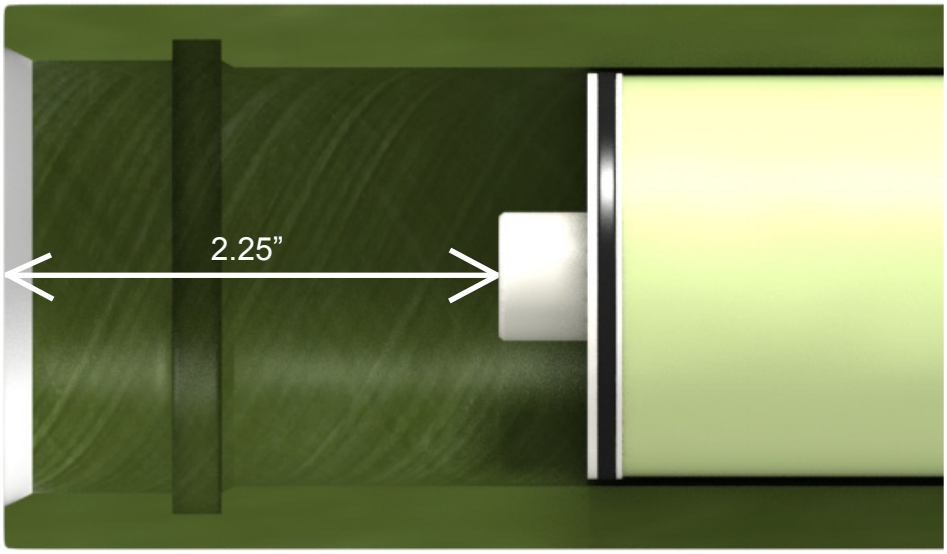
NOTE : If the element becomes caught as the brine seal passes into the vessel do not push harder - this may trap the brine seal and prevent the element from moving in any direction. If the element becomes trapped it will have to be pushed through the vessel using a long piece of wood and the loading procedure started again. Check that the seal is in good condition. If the element is not trapped, carefully remove it a few inches until the brine seal is outside the vessel, apply more glycerine and try again. The element should enter the vessel with light hand pressure.



(d) As each element is loaded insert the interconnector. To ease insertion glycerine should be applied to the O-seals.

(e) Care should be taken to ensure that the weight of the element is not taken on the interconnectors during loading.

(f) The final element should be inserted 2.25” in from the end of the vessel.



1.5 CLOSING VESSEL

1.5.1. Thoroughly clean all parts and check for the following.

(a) O-SEALS - cracked, worn or cut areas.

(b) END CAP - cracks between ports, distorted or bearing edges worn.

(c) 3 PART RETAINING RING - corroded.

Components which show any of the above should be replaced.

NOTE : It is recommended that O-seals are replaced every time the end cap is rebuilt.

1.5.2. CORROSION - Examine metal components for evidence of corrosion which might affect structural performance. Particularly pay attention to the 3 part retaining ring. Components which cannot be restored to the ‘as new’ condition should be replaced.

1.5.3. Check the inside of the vessel for debris which may scratch the vessel. Remove any that is found by flushing with water or by using a clean cloth. Stubborn debris which adheres to the vessel may be removed by lightly polishing the area with waterproof silicone carbide paper. Use 400 Grade (fine) to start with and finish with 600 Grade (very fine). It will help to moisten the grit paper with water during use. Avoid continuously rubbing the same spot in the same direction. Afterwards remove any debris with water or by using a clean cloth.

NOTE : Fine grade Scotchbrite may be substituted for water-proof silicone carbide paper.

1.5.4. Lubricate the vessel inside surfaces with glycerine.

1.5.5. Lubricate the assembled end cap with glycerine, particularly the 2.5" diameter O-seal.

1.5.6. Insert the end cap squarely into the vessel body sufficient to allow the 3 part retaining ring to be inserted fully into the groove in the end of the vessel. If the end fitting is difficult to push into the vessel then use the wooden shaft of a hammer to tap it into position.

NOTE : Under no circumstances should undue force be used to insert the end cap. A light tap is all that is required.

If the end cap cannot be easily inserted then the following checks should be carried out.

(i) Lubricate vessel surfaces with glycerine.

(ii) The elements may have been pushed too far, proceed as follows:

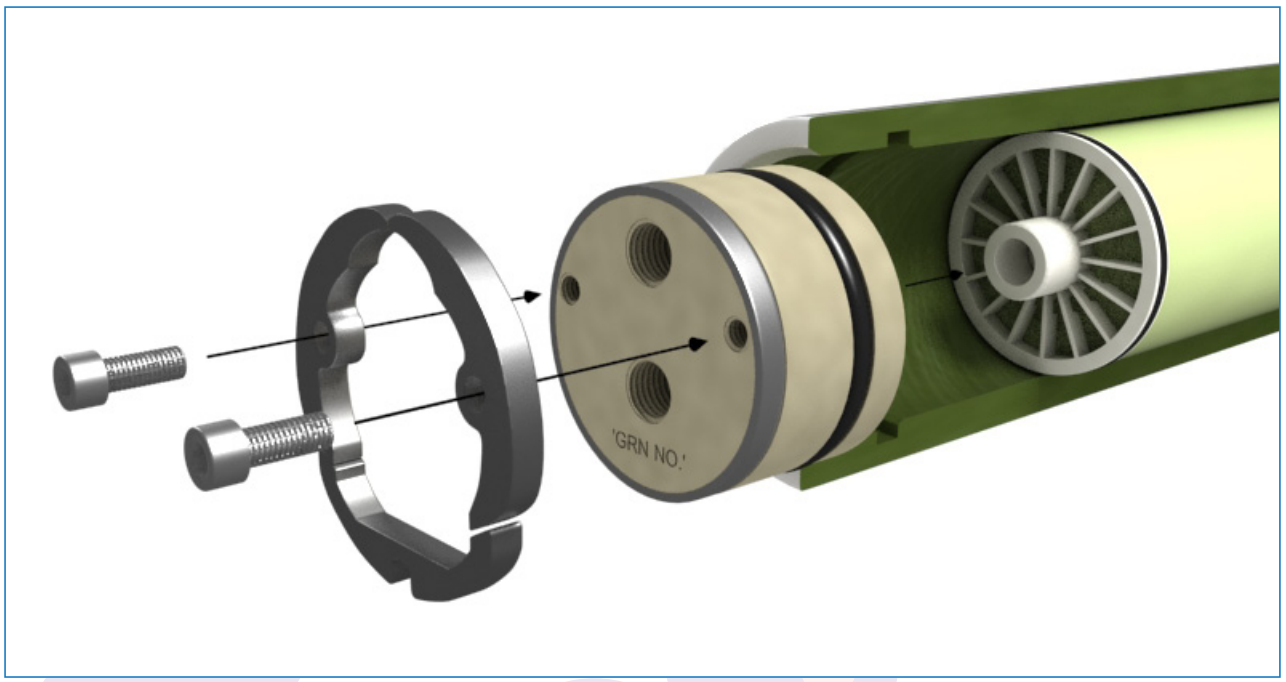
Remove 2.5" diameter seal from end cap.

(iii) Insert end cap into vessel. Without the main seal little effort should be required to connect onto the element. If there is insufficient space to insert the 3 part retaining ring then the elements have been pushed too far during loading. Remove the last element by pushing it through the vessel taking care to support its weight as it emerges. Refer to Section 1.2 `Loading Elements' for further information.

NOTE : Remember to refit all O-seals.

1.5.7. With the end fitting in place insert one of the three part retaining ring segments in place and fix with one of the two M6 cap head screws. Do no tighten the caphead screw but leave loose as this will make for easier location of the remaining pieces. Put both of the remaining pieces into position before inserting the remaining cap head screws. Finally tighten both cap head screws up to a maximum torque of 3Nm.

NOTE : A partially or badly assembled vessel is dangerous.



SECTION TWO

INSTALLATION

2.1 HANDLING

2.1.1 Vessels may be stored horizontally in any warehouse where the temperatures are as follows:

Maximum 45^{o} C (113^{o} F)
Minimum 0^{o} C (32^{o} F)

2.1.2 DO NOT subject the vessel to sharp blows or impacts as this may damage the vessel wall.

2.1.3 DO NOT use the ports which project beyond the vessel as lifting or manoeuvring aids.

2.1.4 DO NOT scratch the vessel inside wall.

VESSEL DAMAGE

This should be reported to the shipping company upon receipt.
Contact Phoenix Vessels for advice if in doubt.

2.2 VESSEL SUPPORT POSITION

The bending stresses generated in a long pressure vessel can be considerable and should not be ignored. Careful choice of support position can minimise bending stresses to an acceptably low level. Always follow instructions stated on the Assembly Drawing for each particular vessel design and length ordered.

The following is the recommended support positions for 2.5" vessels.

No. of 40'' Elements	No. of Supports	Distance between Supports (mm)	
		Max	Min
1 x 14"	2	370	100
1 x 21"	2	550	200
2 x 14"	2	700	300
1 x 40"	2	1000	400
2 x 21"	2	1050	450
2 x 40"	2	1500	860

2.3 CONNECTIONS TO VESSEL

2.3.1 Mount vessels at the recommended support position. If straps are used to hold the vessel then they should be of the flat strip type and the vessel should be mounted on a radiused block which is conformable (the vessel OD is 77 mm).

NOTE : Excessive torque applied to the straps may damage the vessel wall.

2.3.2. Provide pressure relief device. This should be set to no more than 105% of design pressure.

2.3.3. Allow for an expansion of 0.5mm per metre length of vessel at design pressure.

2.3.4. Connections to end cap are 1/4" BSPT female thread. The maximum torque applied to the threaded connections should be as stated in the table below. Note that when the vessel is working in an environment which is hotter than the assembly temperature the thread torque reduces. Similarly as the temperature reduces the assembly torque increases. This is due to the thermal expansion of the thermoplastic end cap. Obviously a lightly torqued fitting may leak at high temperature and so recommended torque figures should be followed. If a pre-set torque wrench is used to tighten the fitting into the end cap make sure that at least three `clicks' are heard i.e. that the torque level is checked at least three times. Often some additional movement is obtained at the second and third attempts.

SECTION THREE

OPERATION

3.1 CORROSION

Whilst every effort has been taken to ensure that end fittings have adequate corrosion resistance it is the responsibility of the purchaser to assess that the materials offered are suitable for the specific corrosion environment.

Alternate materials are available with enhanced corrosion resistance, contact Phoenix Vessel Technology Limited for advice.

End fittings should be maintained dry and free from corrosion. Vessel leaks should be investigated and corrected.

3.2 OPERATING CONDITIONS

DESIGN SPECIFICATION

Internal Diameter: 2.45”

Length: Up to 80” of membrane elements.

Working Fluid: Water (brackish or seawater).

NOTE : The standard materials of construction may not be compatible with cleaning and preserving fluids. Alternative materials are available on request.

Design Pressure: 1000 psi (69.0 bar).

Test Pressure: 1.1 times design pressure for upto 15 minutes maximum.

Design Temperature: 20 to 113^{o} F (-7 to 45^{o} C).

NOTE : Although the minimum design temperature is 20 deg F the vessel should not be allowed to freeze solid. This will damage the vessel wall and make replacement necessary.

Expansion: 0.5 to 0.6 mm per metre length of vessel at design pressure.

Vacuum condition: Down to -14.5 psi (0 bar absolute).

Support Position: 2 supports.

3.3 SAFETY PRECAUTIONS

Fibreglass reinforced pressure vessels will provide years of safe service if properly installed and maintained. This section is for guidance only and should be used in conjunction with the recommendations in the previous sections. Attention is drawn to the `NOTES:` located at the bottom of the page which highlight potential problems areas and safety recommendations.

3.3.1 Provide pressure relief device. This should be set to no more than 105% of design pressure.

3.3.2 Before pressurisation visually check that the 3 part retaining ring is fully in position and secured by the two cap head screws.

3.3.3 DO NOT stand in line of end fitting while pressurisation takes place.

SECTION FOUR

APPENDIX

4.1 SPARE PARTS LIST

For part numbers and descriptions please refer to the relevant Technical Information Sheet.

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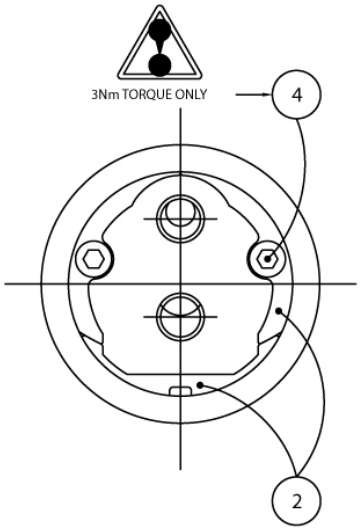
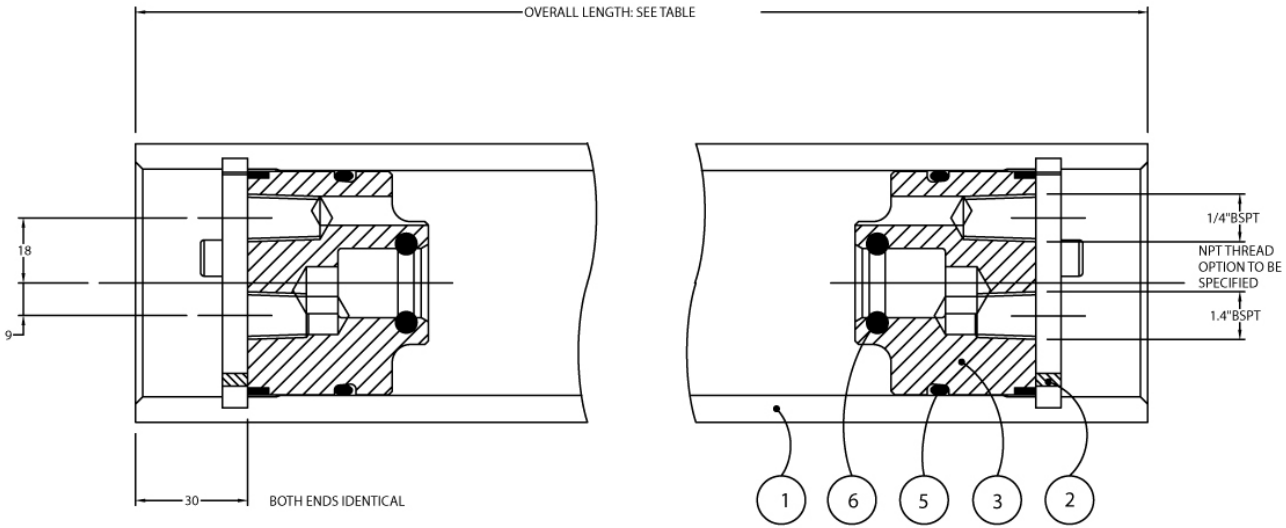
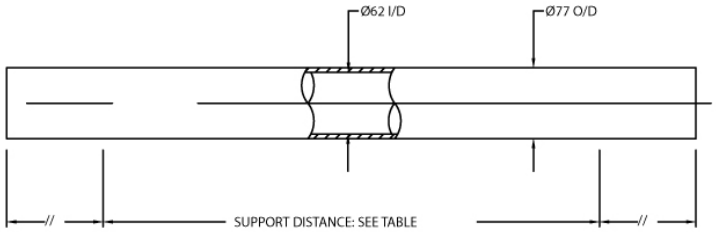






IMPORTANT

This drawing print to be used ONLY for Job Number PH

Date | Signature

TO BE RETAINED IN JOB FILE

6	`O` SEAL FOR MEMBRANE	NITRILE WRC LISTED		TO SUIT MEMBRANE	2
5	`O` SEAL FOR ENDCAP	NITRILE WRC LISTED		200-227-2064	2
4	CAP HEAD SCREW	STAINLESS STEEL		M6 x 1.0 x 16L	4
3	END CAP	ACETAL	1/4" BSPT	PVL 25-10-1536	2
			1/4" NPT	PVL 25-10-1789	
2	RETAINING RING	STAINLESS STEEL 316		PVL 25-10-1537	2
1	VESSEL BODY	GLASS FIBRE EPOXY RESIN		PVL 25-10-1438	1

NO. OF 40" ELEMENTS.	OVERALL LENGTH+/-2mm	MAX SUPPORT POSITION mm	MIN SUPPORT POSITION mm	MAX DRY WEIGHT Kg.
12" X 1b	473	370	100	2.1
14" X 1a	473	370	100	2.1
21" X 1a	651	550	200	2.8
25" X 1b	803	700	300	3.2
14" X 2a	829	700	300	3.4
40" X 1a	1133	1000	400	4.6
40" X 1b	1184	1050	450	4.7
21" X 2a	1184	1050	450	4.7
40" X 2a	2149	1500	860	8.3
40" X 2b	2200	1500	860	8.5
40" X 3a	3165	2000	1600	12.0
40" X 3b	3216	2000	1600	12.3

2.5" PRESSURE VESSEL 1000 PSI , END PORT.

NOTES :

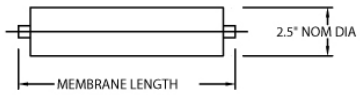
1. GLYCERINE TO BE USED ON `O` SEAL PATHS TO REDUCE FRICTION.

2. REFER TO USERS GUIDE FOR MORE DETAILED INFORMATION ON INSTALLATION, OPERATION, MAINTENNANCE AND SPARES.

3. EACH VESSEL TESTED AT 1.5 TIMES DESIGN PRESSURE FOR 15 MINUTES TO ENSURE NO LEAKS.

4. DESIGN PRESSURE 1000 PSI
DESIGN TEMPERATURE -7°C TO 45°C.
DO NOT ALLOW VESSEL CONTENTS TO FREEZE.

5. SUITABLE FOR MEMBRANES WITH MALE TYPE PERMEATE TUBE



1MNC 1503		SCALE : NONE	
		DIMENSIONS : MILLIMETRES	
ISSUE : G	BY : TDP	APPD : TDP	DATE : 27 MAY 2009